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A cross-cultural study of teachers' relation to curriculum materials

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A number of studies show the complex relation between a teacher and curriculum materials influencing teachers' actions in a mathematics classroom. This study investigates teachers' relation to mathematics curriculum materials in three different cultural-educational contexts, namely in Sweden and in Finnish- and Swedish-speaking parts of Finland. The results are based on a survey among teachers (N = 603) who work in compulsory schools in these three contexts. The results support the previous findings, which show that curriculum materials are experienced by teachers as a guarantee of good quality in mathematics education, but, at the same time, as a burden. Some notable differences were found between teachers with various experiences in different contexts. The findings are discussed in terms of pedagogical design capacity and the specific character of the three contexts.

Keywords: Mathematics education, curriculum materials, teachers, cross-cultural studies, pedagogical design capacity.

Introduction

Recent studies have raised the role of curriculum materials as an important factor, not only for improving the quality of teaching and students' results (e.g. Stein & Kim, 2009), but also for influencing teachers' conceptions and teacher change (e.g. Remillard & Bryans, 2004; Pehkonen, 2004). The focus has also been on the interaction between a teacher and curriculum materials in relation to emerging mathematics classroom practices (e.g. Roth McDuffie & Mather, 2006).

Teaching is widely considered to be a cultural activity (Pepin, Gueudet & Trouche, 2013). This study adds to our knowledge of the complex relation between a teacher and curriculum materials (cf. Remillard, 2005; Brown, 2009) in different cultural-educational contexts (Hemmi & Krzywacki, 2014). The term 'curriculum materials' in our study refers to commercially produced materials used in school education, such as student textbooks and teacher guides. The focus of the paper is particularly on this relation from the viewpoints of teachers, and the first results of a cross-cultural project on how compulsory school teachers in Finland and Sweden relate to mathematics curriculum materials are reported. We consider the teacher as part of the social practices embedded in certain cultural norms (cf. see also Hill & Charalambous, 2012). Hence, the study joins a fairly large body of work that aims to compare systematic mathematics teaching and learning practices across different cultures (e.g. Andrews, 2007).

Swedish and Finnish cultural-educational contexts resemble each other in many ways; for example, the national steering documents set only a non-specific outline for the school system, and teachers have free choice and use of curriculum materials and how to implement the curriculum. In both

countries, commercially produced materials are in accordance with the core curriculum but neither regulation of curriculum materials nor inspection take place. (e.g. Hemmi & Ryve, 2015; Kaasila, Hannula, Laine & Pehkonen, 2008). Yet, there are considerable differences in how teachers organize mathematics teaching, in the character of curriculum materials, and how they are utilized by teachers in these two countries (e.g. Hemmi & Krzywacki, 2014). In Finland, mathematics teaching at the lower secondary level appears rather teacher-centred (Andrews, Ryve, Hemmi & Sayers, 2014) while at the primary level a certain cultural script (see e.g. Andrews, 2007) with various reoccurring lesson events have been identified both in the Finnish context (Hemmi & Ryve, 2015) and the curriculum materials (Hemmi, Krzywacki & Koljonen, in press). This is not necessarily the case with the Finnish Swedish mathematics materials and classrooms. In Sweden, students usually work with their textbooks at their own pace without any teaching (Boesen, Helenius, Bergqvist, Bergqvist, Lithner, Palm & Palmberg, 2014) and the Swedish curriculum materials vary greatly, at least at the elementary school level (Neuman, Hemmi, Ryve & Wiberg, 2013).

Approximately 90% of Finnish teachers are qualified (Opettajat Suomessa, 2013) but in the Swedish-speaking part of Finland, there are a few more unqualified teachers (about 20%) than the Finnish-speaking part. Over 30% of Swedish teachers teaching mathematics in compulsory school lack qualifications for the task (Skolverket, 2015). In Sweden, neither curriculum materials nor teaching methods have been the focus of the teacher education that only recently was reformed to become research-based. In Finland, the aim of teacher education has been for decades to educate autonomous independent teachers who research and reflect on their own work.

This paper draws on a quantitative survey of compulsory school teachers (grades 1-9) in Finland and Sweden and focuses on how teachers in different cultural-educational contexts relate to mathematics curriculum materials. In our study, we look at the Swedish-speaking and Finnish-speaking teachers in Finland separately due to the existence of possible differences in the teaching cultures between the language groups. Research questions are:

1. To what extent do teachers think of the curriculum materials as means to guarantee the even quality of mathematics teaching? Are there differences between cultural- educational contexts?
2. To what extent do teachers perceive the curriculum materials as burdens in mathematics teaching? Are there differences between cultural-educational contexts?

The relationship between teacher and curriculum material

The complex relationship between teachers and curriculum materials has been examined with the use of several theoretical frameworks (Brown, 2009; Remillard & Bryans, 2004). Remillard (2005) distinguishes theoretical perspectives characterising teachers' relation to curriculum materials in terms of fidelity to, interpretation of or participation with curriculum materials. This study engages with the third approach, participatory relationship view, which highlights the dynamic interrelationship between teachers and materials. The activity of using or participating with the curriculum resource is influenced by various individual factors such as teacher knowledge, beliefs and goals, perception of curriculum and students, tolerance for discomfort and professional identity (Remillard, 2005; Brown, 2002). Furthermore, general pedagogical trends and cultural traditions

may affect teachers' views on teacher professionalism and thus their relationship with curriculum materials (e.g. Hemmi & Krzywacki, 2014). Therefore, research results should be considered in the light of different education cultures

Brown (2009) proposes the construct of Pedagogical Design Capacity (PDC) to describe a teacher's capacity to perceive and customize curriculum resources in order to design and enact instructional episodes, meet perceived student needs and achieve instructional objectives. Teaching experience is influential in enhancing teachers' readiness. According to Brown (2009), pedagogical design capacity may emerge over time, as familiarity with the pedagogical affordances of available resources and ability to use them increases. In addition to factors related to teachers as users, the character of the materials — for example, their flexibility and structure (Brown, 2009; Remillard, 2002) — naturally has an impact on the participatory relationship.

The materials can both afford and constrain teachers' actions in mathematics classrooms (e.g. Brown, 2009). Roth McDuffie and Mather (2006) stress that teachers should use the instructional materials to support instruction, rather than allow them to prescribe instruction. According to Pehkonen (2007), teachers may feel guilty leaning solely on textbooks rather than their own planning when teaching. Although the Finnish teachers found the materials very good, they thought they had 'given up a part of their professional competence to the textbook authors' (Pehkonen, 2007). Remillard and Bryans (2004) show that teachers have different orientations toward using new curriculum resources, which influence the way they utilize them in practice. The orientations depend on the extent to which teachers familiarize themselves with the teaching material. Inexperienced teachers are most likely to engage fully with available resources (Remillard and Bryans, 2004), whereas teachers with more self-confidence are less dependent on curriculum materials (Stipek, Givvin, Salmon & MacGyvers 2001).

Methodology

The respondents in this study were comprehensive school teachers in Finland and Sweden ($N=603$) who voluntarily agreed to answer. The sample consisted of Finnish-speaking ($N_{FIN}=209$) and Swedish-speaking teachers ($N_{FINSWE}=200$) in Finnish schools, and Swedish teachers ($N_{SWE}=194$) working in Swedish schools. Female teachers were overrepresented in the sample ($N_f=529$, $N_m = 71$). The data was collected via e-questionnaire by announcing a request to participate on various teachers' professional network forums. In addition, the Swedish data was partly collected with paper forms during in-service teacher education.

The data collection instrument of the study was created based on previous qualitative studies of interviews with Finnish teachers (Pehkonen, 2004; 2007). In those studies, three qualitatively different ways to speak about the use mathematics curriculum materials had been identified: 1) justification (assuring the even quality of teaching, supporting changes); 2) criticism of textbooks and the use of them; and 3) expressions of guilt. The questionnaire was constructed based on those dimensions and the items were formulated convergent with the teachers' statements. The instrument was modified through testing pilot versions in various data sets based on different teacher populations.

The questionnaire comprises 39 items (statements) that were shown in blocks of five statements in a random order. Thus, the respondents could focus on five statements at a time. No headings was shown labelling the blocks. The respondents were asked to take a stand on each item on a five-point Likert-scale (1 = totally disagree, 5 = totally agree). The paper form followed the same structure and order of the statements despite grouping into blocks of five items.

The three dimensions (factors) with the resemblance to the original dimension were extracted in explorative factor-analysis (GSL and Varimax-rotation) and found in all used data sets. We omitted the items with loadings over .40 on two factors, and the items with loadings under .40 on each factor. The first factor was named ‘quality guarantee’, and the constructed subscale was consisted of nine items. In the entire data set, the Cronbach’s alpha was .87, and it varied from .85 to .89 in the three separate data sets. The second subscale ‘burden’ comprised eight items (of the second factor) with the alpha coefficient of .83 in the entire data, and in separate data sets .80_{FINSWE}, .84_{SWE} and .85_{FIN}, respectively. The third constructed subscale (based on the third factor) measured teachers’ self-confidence in mathematics teaching. It consisted of six items, and the Cronbach’s alpha in the entire data set was .728 with variation from .720 to .751 in separate data sets. In this paper, we concentrate on reporting the findings regarding the first and the second subscale.

Table 1. Subscales and Cronbach’s alphas in various data sets

SUBSCALE	Quality guarantee	Burden	Confidence
ITEMS	N = 9	N = 8	N = 6
Alpha TOTAL	.874	.831	.728
Alpha FIN	.892	.852	.720
Alpha FINSWE	.854	.804	.751
Alpha SWE	.858	.840	.739

Results

Our first research question concerns the extent to which teachers conceived the curriculum materials as a means to guarantee the high and even quality in mathematics teaching. The scale contained nine items, like ‘Textbooks help me to assure the quality of instruction’. In total, the teachers found that curriculum materials are somewhat helpful in assuring the quality of mathematics teaching. The arithmetic mean on this subscale was 3.38 (SD = .77). However, differences were found between teachers working in different cultural-educational contexts. The Finland-Swedish teachers had the highest mean (= 3.63) and smallest standard deviation (= .70), whereas the Finland-Finnish teachers had the lowest mean (= 3.18) and greatest standard deviation (= .82) (see Table 2).

The differences between the groups were statistically significant ($F(2, 597) = 18.296$; $p < .001$). The effect size was mediocre (eta squared = .06). The variances between groups were not homogenous, so the mean differences were localised by Tamhane’s T2-test. It indicated that the differences between means were due to the Finland-Swedish teachers, who differed both from their Finnish and their Swedish colleagues. The Finland-Swedish teachers in our data had the highest

confidence in using the mathematics curriculum materials as quality guarantees in mathematics teaching. Teachers' gender, age and teaching experience were not related in this respect.

Table 2. Curriculum materials as means to guarantee high and even quality in mathematics teaching and as burden

	Mean (QG)	Std. Dev	Mean (B)	Std. Dev.
Finland-Finnish teachers	3.18	.82	2.55	.84
Finland-Swedish teachers	3.63	.70	2.71	.71
Swedish teachers	3.35	.72	2.55	.76
TOTAL	3.38	.77	2.60	.78

Secondly, we answer the question 'To what extent do the teachers conceive the curriculum materials as burdens in their work?' The subscale measuring this dimension included eight items like 'Since the mathematics textbook keeps us so busy, we do almost nothing else in mathematics classes'. On the five-point scale (from 1 to 5, where 5 refers to a very high burden), the mean of the burden scale in the entire data set was somewhat below the middle point ($M = 2.60$; $SD = .78$). The means and standard deviations are presented in Table 2 above.

On average, the Finland-Swedish teachers found the curriculum materials the most burdensome with the highest scale mean of 2.71 and lowest standard deviation ($= .71$). The Finnish and Swedish teachers scored somewhat lower ($M_{FIN} = 2.55$ and $M_{SWE} = 2.55$; SDs .84 and .76, respectively). However, the differences between cultural-educational contexts were not statistically significant, though the Finland-Swedes were borderline outliers.

To obtain a somewhat sharper picture of the situation, we selected teachers with a scale mean slightly above the middle point, i.e. $M > 3.5$. Of all the teachers, 11.4 % ($N=69$ out of the total $N=603$) who scored above this limit found that the curriculum materials put a strain on them. Most of these were Finland-Swedish teachers. On the whole, around 13% of Finland-Swedish teachers in our data shared these experiences. We continued by selecting those teachers with a relatively high mean scale ($M > 4$), which indicated that they found the materials even more burdensome. In the whole data set, approximately 4% of teachers reported that curriculum materials created a considerable burden for their work.

Overall, the length of teaching experience was found to be related to experiencing curriculum materials as a burden. Teachers with little (under two years) or a significant amount of (more than ten years) teaching experience found the curriculum materials to be much less of a burden ($M_{te < 2} = 2.64$; $M_{te > 10} = 2.49$) than the teachers with teaching experience between two to ten years ($M_{te 2-10} = 2.88$); $F(2, 599) = 16.033$; $p < .001$, eta squared = .05)

Female teachers found the curriculum materials more burdensome ($M_f = 2.65$, $SD = .786$) than their male colleagues ($M_m = 2.33$, $SD = .67$). The difference between the means was statistically significant ($t = 3.04$, $p = .002$), but the effect size was small (eta squared = .02).

Discussion

Curriculum materials are important tools for teachers when designing and enacting teaching (e.g. Brown, 2009). The way teachers relate to curriculum materials plays an important role for how productively they utilize these resources. All the teachers of our study found curriculum materials somewhat helpful in assuring the quality of mathematics teaching. However, the Finland-Swedish teachers differed significantly from both their Finnish and Swedish colleagues in that they had the highest confidence in the curriculum materials as a quality guarantee in mathematics teaching regardless of gender, age or teaching experience. In the Swedish part of Finland, it has been common to use restricted variety of curriculum materials that are typically developed by the teacher educators who also educate future teachers in the only Swedish elementary teacher education in Finland. This might explain why the Finland-Swedish teachers put more trust in the quality of available curriculum resources.

Curriculum materials are not considered a heavy burden by any group of teachers. Although it is not a statistically significant difference, it is worth noting that the Finland-Swedish teachers also stood out from the other teacher groups by finding curriculum materials more burdensome than the others. It is possible that teachers who consider the curriculum material a guarantee of quality feel guilty if they cannot follow the material in the way that they conceive the underlying idea. On the level of the entire data set, teaching experience seemed to have the most powerful impact on experiencing burden (cf. Brown, 2009). Teachers with either a little or a lot of experience in teaching mathematics found the curriculum materials significantly less burdensome than the teachers with two to ten years of experience. On the one hand, newly graduated teachers possibly appreciate curriculum materials especially because the materials help them in teaching by familiarizing them with the contents and goals of particular grade levels. On the other hand, teachers with a long teaching experience feel hardly stress for the way they utilise the available materials. As stated by Brown (2009), pedagogical design capacity emerges over experience and practice, and the more experienced teachers have developed their capacity to customize the materials for their purposes. Therefore, the material is not found as a burden but rather a support for teaching (cf. Remillard and Bryans 2004; see also Hemmi & Krzywacki, 2014).

The constraints and affordances experienced by teachers utilizing curriculum materials should also be discussed in terms of different teaching traditions. We expected to find differences between Finland and Sweden particularly due to the differences in classroom cultures teacher education (Hemmi & Ryve, 2015) and curriculum materials (Hemmi et al., in press; Neuman et al., 2013). Contrary to our expectations, we found no particular differences between the Finnish and Swedish teachers' relation to curriculum materials. The difference could be found, however, within Finland between two language groups. A possible explanation could be that the curriculum materials are developed within a certain cultural-educational context and, therefore, could be in line with the prevailing teaching tradition and social practices within the cultural norms internalised by teachers (cf. Hill & Charalambous, 2012).

There are some limitations resulting from self-selection that generates a special sample of three cultural settings. The respondents were those who voluntarily decided to answer to the

questionnaire, which may have resulted in some biases in the data. First, the female teachers are over-represented in our data. About 74% of comprehensive school teachers are women in both Finland and Sweden, while 85% of the Finnish and 96% of the Swedish respondents of the study were women. Second, the respondents in our study were somewhat more qualified than teachers on average.

Curriculum materials can be experienced as a burden rather than an affordance if pedagogical design capacity is undeveloped and a teacher cannot utilize resources flexibly but struggles with achieving fidelity between the written and enacted curriculum (cf. Brown, 2009; Pehkonen, 2007). Our findings indicate that there could be some general cross-cutting patterns connected to teachers' experience of curriculum materials as a burden. Those might possibly be connected to pedagogical design capacity (Brown, 2009) but also to the general view of teacher professionalism and the material to which they are accustomed. Further investigation could enlighten both the similarities and differences in the teachers' relation to curriculum materials in the three different educational contexts. For example, it would be interesting to study deeper how teachers perceive and customize curriculum materials in practice and what the role of the curriculum materials is as a part of everyday work in the classroom.

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